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10/695,249

10/27/2003

Valery M. Dubin

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MICHAEL A. BERNADICOU
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 WILSHIRE BOULEVARD,
SEVENTH FLOOR
LOS ANGELES, CA 90025

EXAMINER

LE, DUNG ANH

ART UNIT

PAPER NUMBER

2818

DATE MAILED: 03/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/695,249

Applicant(s)

DUBIN ET AL.

Examiner

DUNG A. LE

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,8,10-17,27 and 29 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☐ Claim(s) 1-5,8,10-17,27 and 29 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

DETAILED ACTION

Claim Objections

Claims 11,13- 15 are objected to because of the following informalities:.

In claim 11, change the term “ second material” to -- silver -- in order to particularly define the subject matter which Applicants regard as the invention.

In claims 13-15, change the term “ second material” to -- metal more noble than copper -- in order to particularly define the subject matter which Applicants regard as the invention.

Claim Rejections

Claim Rejections - 35 USC § 112

Claims 11, 16 and 27 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The limitation in claim 11, ‘a predetermined solubility’ is vague and indefinite. It is not clear which solubility is desired.

In claim 16, line 4, “ the first material” lacks antecedent basis, claim 15 provides the antecedent basic for this term.

In claim 16, the language of “ a predetermined temperature and time ” is vague and indefinite. It is not clear which temperature and time are desired.

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The limitation in claim 27, 'a predetermined solubility' is vague and indefinite. It is not clear which solubility is desired.

Set of claims 1-10 and 13-17.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1- 10 are rejected under 35 USC 102 (e) as being anticipated by Kripesh et al. (2002/0175424 A1).

Kripesh et al. teach a method for making a semiconductor device comprising:

forming a conductive path 43 on a substrate (especially refer to figs. 4A-11 and related text) the conductive path made of copper;

depositing a metal more noble than copper 51/61/81 on the conductive path 51, from an aqueous solution by immersion plating [0031]; and

facilitating a diffusion ([0031], [0037] and [0046])of the metal more noble than copper into the conductive path, the metal more noble than copper having a

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low solubility to substantially diffuse into grain boundaries of the conductive path to significantly increase reliability of the conductive path.

Regarding claim 2, wherein the metal-metal more noble than copper comprises platinum [0030].

Regarding claim 3, wherein the metal is upper the metal more noble than copper comprise rhodium [see claim 10 and 54 of prior art].

Regarding claim 4, wherein forming the conductive path 43 comprises a damascene process.

Regarding claim 5, wherein the metal more noble than copper comprises gold [see claim 10 and 54 of prior art].

Regarding claim 7, wherein the metal more noble than copper comprises ruthenium [see claim 10 and 54 of prior art].

Regarding claim 8, metal more noble than copper comprises osmium [see claim 10 and 54 of prior art].

Regarding claim 10, wherein the metal more noble than copper comprises iridium [see claim 10 and 54 of prior art].

Regarding claim 15, wherein facilitating diffusion of the second material comprises heat treating [0037] the conductive path 43 having the deposited second material 51.

Regarding claim 17, wherein the conductive path 43 comprises at least of one of a conductive line and a conductive interconnect.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 13 and 16 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Kripesh et al. in view of Sinha et al. (2004/0157433 A1) or the following remark.

Regarding claims 13- 14, Kripesh et al. teaches the claimed invention as applied to claim 1, but fail to teach depositing the second material comprises depositing the second material before a planarization process of the substrate having the conductive path.

Sinha et al. teach depositing the second material 40 comprises depositing the second material 40 before a planarization process of the substrate having the conductive path 30.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to deposit the second material comprises depositing the second material before a planarization process of the substrate having the conductive path in Kripesh et al. 's method in order to improve metal to copper

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adherence, uniform metal deposition over the interconnects and which can be used to produce a good bond with other bonding materials [0009].

Regarding claim 14, wherein depositing the second material comprises removing an oxide from the conductive path, immersing the conductive path in an aqueous solution having at least the second material and providing a planarization process of the substrate having the conductive path(Kripesh et al. [0030]).

Regarding claim 16, Kripesh et al. teaches the claimed invention as applied to claim 1 and 15 including a heat treatment except for heat treating the conductive path comprises annealing the conductive path at a predetermined temperature and time to substantially diffuse the second material to the grain boundaries within the first material, the predetermined temperature and time based at least in part on the first and second material as cited in current claim.

However, it would have been obvious to one having ordinary skill in the art making semiconductor device to determine the workable or optimal value for heat treating the conductive path comprises annealing the conductive path at a predetermined temperature and time to substantially diffuse the second material to the grain boundaries within the first material, the predetermined temperature and time based at least in part on the first and second material through routine experimentation and optimization to optimal device performance.

Set of claims 11-12

Claims 13 and 16 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Kripesh et al. in view of Sinha et al. (2004/0157433 A1).

Kripesh et al. teach a method for making a semiconductor device (especially refer to figs. 4A-11 and related text) comprising:

forming a conductive path 43 on a substrate, the conductive path made of copper;

depositing a silver 51/61/81 [0030] on the conductive path by immersion plating [0031]; and

facilitating a diffusion ([0031] [0037]and [0046]) of the second material into the conductive path, the second material having a predetermined solubility to substantially diffuse to at least one of an interface and grain boundaries within the first material to significantly increase reliability of the conductive path.

Kripesh et al. do not teach subsequent to planarizing the substrate having the conductive path.

Sinha et al. teach depositing a silver 40 on the conductive path 30 by immersion plating; subsequent to planarizing the substrate having the conductive path 30.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to deposit the second material comprises depositing

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the second material before a planarization process of the substrate having the conductive path in Kripesh et al. 's method in order to improve metal to copper adherence, uniform metal deposition over the interconnects and which can be used to produce a good bond with other bonding materials [0009].

Regarding claim 12, wherein depositing the second material comprises removing an oxide from the conductive path, and immersing the conductive path in an aqueous solution having at least the second material (para. [0030] of Sinha).

Set of claims 27 and 29

Claims 27 and 29 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Kripesh et al. in view of Han et al. (6,924,234 B2).

Kripesh et al. teach a method for making a semiconductor device comprising:

forming a conductive path 43 on a substrate, the conductive path made of a first material;

depositing a second material 51/61/81 on the conductive path; and

facilitating a diffusion [0031] [0037] and 0046] of the second material into the conductive path, the second material having a predetermined solubility to substantially diffuse to at least one of an interface and grain boundaries within the first material to significantly increase reliability of the conductive path.

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Kripesh et al. does not teach removing an oxide from the conductive path by etching the conductive path with a medium having a mildly acidic or mildly basic solution.

Han et al. teach removing an oxide from the conductive path by etching the conductive path with a medium having a mildly acidic or mildly basic solution (figs. 2E-2G and col 4, lines 1-17).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to remove an oxide from the conductive path by etching the conductive path with a medium having a mildly acidic or mildly basic solution in Kripesh 's method in order to improve planarization, while mitigating scratched during fabricating and improvement (col 2, line 35-40 and col 3, lines 10-15).

Regarding claim 27, Kripesh (claim 10 on page 14) discloses the second material further comprises at least one of silver, gold, palladium, ruthenium, rhodium, osmium, iridium, and platinum.

When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond

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within the period for response will cause the application to become abandoned

(see M.P.E.P 710.02(b)).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is (571) 272-1784. The examiner can normally be reached on Monday-Tuesday and Thursday 6:00am-4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The central fax phone numbers for the organization where this application or proceeding is assigned are (571)272-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DUNG A. LE
Primary Examiner
Art Unit 2818

